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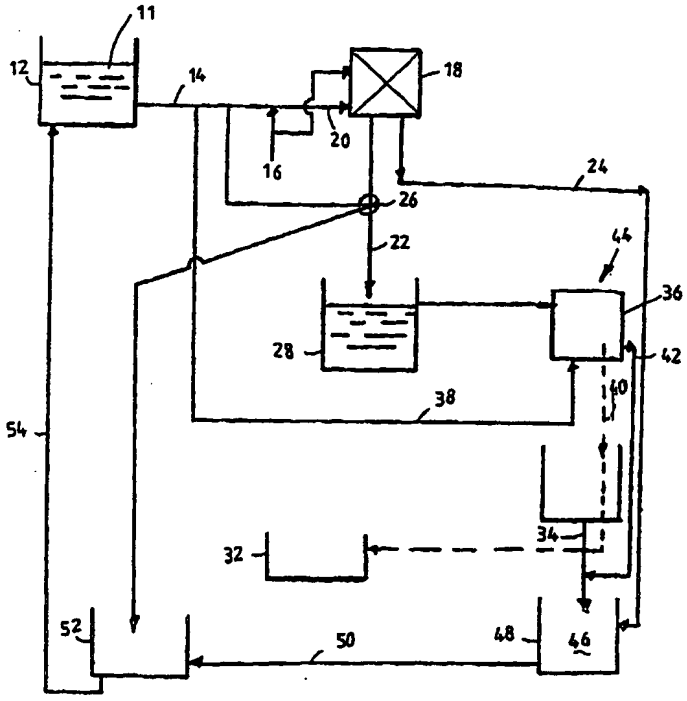
(54) Title: AQUEOUS SOLUTION FOR DISINFECTING AN ANIMAL PRODUCT, A METHOD AND A PLANT FOR SUCH DISINFECTION

(57) Abstract

A composition for disinfecting an animal product comprising an electro–chemically activated, anion–containing aqueous solution. A plant for treating an animal product including a water reservoir (12), a salt feed device (16) for creating an aqueous salt solution, an electrolysis device (18) to produce anolyrte and catolyte solutions, an anion mixing tank (28), and a treatment container (30) to apply the solution to an animal product.



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AQUEOUS SOLUTION FOR DISINFECTING AN ANIMAL PRODUCT, A METHOD AND A PLANT FOR SUCH DISINFECTION

This invention relates to a composition for disinfecting an animal product, to a method of disinfecting an animal product, to a treatment plant and to an animal product disinfected with such a composition.

Background to the Invention:

For the purposes of this specification, the term "animal product" should be construed to include within its meaning the carcass or a product obtained from the carcass of an animal, including its skin, coat, hide or feathers and the word "animal" should be construed to include within its meaning sheep, cattle, goats, pigs, chickens, ostriches, fish and the like from which a carcass or a product could be obtained. The Applicant envisages further that the invention will be applicable particularly, but not exclusively, to the treatment of animal products in the form of food and food-related products. Such products include fish, meat and meat-related products such as sausage casings, offal, waste produced in meat-producing plants such as fisheries, abattoirs and the like. It is also envisaged that treatment would result in shelf life extension through decontamination of the various products.

Object of the Invention :

It is accordingly an object of the invention to provide a novel composition for disinfecting animal products as well as the related animal products and method.

Summary of the Invention :

In accordance with a first aspect of the invention there is provided a method of disinfecting an animal product, the method including the step of exposing the animal product to a composition comprising an electro-chemically activated, anion-containing aqueous solution.

The solution may be an aqueous solution of a salt. The salt may be sodium chloride. In particular, it may be non-iodated sodium chloride or potassium chloride.

The method may include the steps of diluting the anion-containing solution to a pre-determined concentration and exposing the animal product to an appropriate quantity of the diluted anion-containing solution and for a predetermined time period in a treatment facility.

If desired, the method may include a preliminary step of washing or rinsing the animal product in a washing vessel prior to treatment in the treatment container. Washing or rinsing may be with water obtained from the said source of water. The method may then include collecting effluent water from the washing vessel, clarifying the effluent water by exposing it to an appropriate quantity of the cation-containing solution, disinfecting the clarified water by treating it with an appropriate quantity of the diluted anion-containing

solution and re-circulating the clarified and disinfected water.

The anion-containing solution and the cation-containing solution may be produced by an electro-chemical reactor or so-called electrolysis device. The electro chemical reactor may include a through flow, electro chemical cell having two co-axial cylindrical electrodes with a coaxial diaphragm between them so as to separate an annular inter electrode space into a catalytic and an analytic chamber. The anion-containing solution is referred to hereinafter for brevity as the "anolyte solution" and the cation-containing solution is referred to hereinafter for brevity as the "catholyte solution".

During the electrolysis process, various radical cation and radical anion species are produced. Generally, a 10% aqueous NaCl solution of water is added to tap water where it is electrolysed in the anion and cation chambers to produce radical cation and radical anion species having extremely high redox potentials of between +500 and +1170 mV and about -980 mV respectively. These species may be labile after about 96 hours with no residues so as to disappear being produced.

The anolyte solution generally may have a pH of about 2-8 and a redox potential of about +1170 mV. The species present in the anolyte solution may include ClO ; ClO^-; HClO; OH^-; HO_2^-; H_2O_2 ; O_3 ; $S_2O_8^{2-}$ and $Cl_2O_6^{2-}$.

These species have been found to have a synergistic anti-bacterial effect which is generally stronger than that of chemical bactericides and has been found to be particularly effective against viral organisms and spore and cyst forming bacteria.

The catholyte solution generally may have a pH of about 12-13. The species present in the catholyte solution may include NaOH; KOH; $CA(OH)_2$.; Mg $(OH)_2$; $HO^{\cdot}$; $H_3O_2^{\cdot}$; HO_2^{-}; $H_2O_2^{-}$; $O_2^{\cdot}$; OH^{-}; O_2^{2-}.

Exposing the animal product or carcass to the anolyte solution may include soaking, rinsing or dipping the animal product in the anolyte solution, applying the anolyte solution via an atomising or fogging process or freezing the anolyte solution and using the ice produced to pack the animal product. The soaking, rinsing or dipping process is suitable for products such as offal which can be handled with relative ease, either manually or mechanically. The redox potential of the anolyte solution can be monitored during the process so that the disinfecting process can be monitored and controlled on a continuous basis. The atomising or fogging process is suitable for products such as carcasses when suspended in a chiller. The atomising or fogging process may include the step of atomising the anolyte solution into the atmosphere in an enclosure to be treated, forming droplets of between 5 and 100 micrometres. The atomising or fogging process is preferably repeated at pre-determined intervals

so as to maintain a suitable level of anolyte solution concentration in the atmosphere, thus using the optimum microcidal and other properties of the anolyte solution in accordance with the required administration rate. The anolyte solution also may be applied by an atomising process in air ducting systems to destroy air-borne micro-organisms. The use of frozen anolyte solution has been found to extend the usable life of animal products packed in the frozen anolyte solution, eg. fish;

In accordance with a second aspect of the invention, there is provided a treatment plant for treating an animal product in accordance with the method of the invention.

The treatment plant may include

supply means for supplying water;

feed means for feeding a suitable salt into the water to produce an aqueous salt solution;

an electrolysis device for electrolysing the aqueous solution to produce an anolyte and a catholyte solution;

a mixing and dilution tank for mixing and diluting the anolyte solution; and

means for applying the anolyte solution to a product.

The treatment plant may include recycling means for recycling anolyte and catholyte solution into spent process water to disinfect the spent process water.

In accordance with a third aspect of the invention there is provided a composition for disinfecting an animal product comprising an electro chemically activated anion containing aqueous solution, the solution being substantially as herein defined.

In accordance with a fourth aspect of the invention there is provided an animal product characterized in having been disinfected with a composition and/or in a plant or a process as herein defined.

Detailed Description of the Invention :

Preferred embodiments of the invention will now be described by way of an example, with reference to the accompanying schematic drawing illustrating a treatment plant in accordance with the invention, and by way of tests with reference to the tables.

With reference to the drawing, drinking quality water is provided as shown at 11 in a water reservoir 12. If the process and the plant is to be operated with water inferior to drinking quality water, a pre-treatment step may be executed in the water reservoir 12, or in a container upstream of the water reservoir 12.

to raise the quality of the water to that of drinking quality water.

A mother line 14 conducts water from the water reservoir 12 to wherever drinking quality water is required in the process as will become apparent hereinafter.

Reference numeral 18 indicates an electro-chemical reactor or so-called electrolysis device. Water from the motherline 14 is exposed to sodium chloride as indicated at 16 to produce a sodium chloride solution. The sodium chloride solution is fed into the electrolysis device 18, as well as water from the water reservoir as indicated by reference numeral 20. By electrolysis, an anion-containing solution or anolyte solution is produced as indicated by reference numeral 22. Also a cation-containing solution or catholyte solution is produced as indicated by reference numeral 24.

The anolyte solution at 22 is admixed with water from the motherline in a manifold valve 26 to produce an anolyte solution of predetermined strength which can selectively be directed into an anion mixing tank 28.

Animal product to be treated in accordance with the invention, for example an offal in an abattoir, is introduced into a washing container 36 as indicated by reference numeral 44. In the washing container 36, water is drawn from the

motherline 14 as indicated at 38 to wash the animal product. After washing, the animal product is transported as indicated by reference numeral 40 into a treatment container 30. Effluent water is collected from the washing container 36 as indicated by reference numeral 42.

The pre-washed animal product is exposed in the treatment container 30 to an appropriate quantity of the anolyte solution from the mixing tank 28 to disinfect the animal product. The disinfected animal product is transported to a product processing and packaging station 32 where it is further processed. Used solution after disinfection is collected from the treatment container 30 as indicated by reference numeral 34.

The effluent water at 42 and the used solution at 34 are added and are conducted as indicated by reference numeral 46 to a clarification container 48 where it is exposed to an appropriate quantity of the catholyte solution 24 to clarify it by means of flocculation, clarification or the like. The clarified water is conducted as indicated by reference numeral 50 to a disinfecting container 52 where an appropriate quantity of the anolyte solution of predetermined strength is obtained via the manifold valve 26 to produce disinfected water which is re-circulated to the water reservoir 12 as indicated by reference numeral 54.

Tests

An electro chemical reactor, including a through flow electro chemical cell having coaxial cylindrical electrodes with a coaxial diaphragm between them so as to separate an annular inter electrode space into a catalytic and an analytic chamber, was used to produce anolyte and catholyte for the tests.

Tests to 1 - 9

In a series of 9 tests, the bactericidal and shelf-life prolonging effect of the anolyte solution was tested on animal products such as offal, meat, fish, hides, etc.. The experimental protocol and the subsequent results are summarised in Table 1 below in which the experiments are numbered from 1 to 9.

In test 4, 3 bovine livers were submerged consecutively for 2 minutes. Redox depletion was measured after each submersion as well as microbiological counts.

Test 10

A further test was conducted to determine the microbiological quality of beef carcasses after having been fogged with anolyte.

Treatment

During the test 24 beef carcasses were used, 12 for a control group and 12 for a test group. The 12 carcasses from the control group and the 12 carcasses from the test group were all microbiologically sampled directly after slaughter. After the carcasses had been placed in the respective chillers, the 12 beef carcasses from the test group were fogged with Anolyte. All the beef carcasses (treated and controls) were microbiologically monitored after the fogging process was completed.

Microbiological sampling

All the carcasses were microbiologically monitored using rodac plates. Samples were taken at 4 positions on both the left and right sides of each carcass i.e. the

- Lateral surface at the 7th and 8th vertebrae;
- Medial side of the hind limb;
- Carcass surface at the breast area of the 7th and 8th rib;
- Proximal part of the neck area; and
- Carcass surface in the perineal region.

After sampling, the rodac plates were incubated at 25°C for 3 days. A total count per 24cm^2 was then determined.

Statistical analysis

An ANOVA procedure was used to determine differences statistically between treatments.

A statistical analysis of the total count of the 12 control and 12 test carcasses is shown in Table 2.

A total count of the beef carcasses of both the control and the test group is shown in Table 3.

Microbiological evaluation

According to the statistical analysis the microbial contamination of the 12 Anolyte treated carcasses was significantly lower after fogging than the contamination level of the control carcasses (Table 2:P=0,0001).

Table 3 clearly indicates that the total count of the control group of carcasses vs the test group of carcasses were at a similar levels just after slaughter (log 1,6/24 cm^2). However, the total count of the test group was significantly reduced after fogging from log 1,6/24 cm^2 to log 0,54/24cm^2. The test group beef carcasses therefore had significantly lower total counts than the control group beef carcasses.

Test 11 - 16

A further series of tests were conducted with Anolyte aimed at preventing the oxidation of meat. During the trials the following meat cuts were used : beef loin steaks, beef topside mince and chicken drumsticks.

Treatment

The treatment groups were as follows :

1. Control
2. Anolyte
3. Anolyte-H_2O-Catolyte
4. Catolyte.

All the rump and loin steaks, as well as the chicken drumsticks were submerged into the respective treatment liquids for a period of 3 minutes. The topside mince was treated with a hand held sprayer.

Shelf life study

After each treatment, all the cuts were singly placed on polystyrene trays and overwrapped with PVC. All the cuts were then placed in retail display cabinets and displayed for a period of 24, 48, 72 and 96 hours at 4°C. After each subsequent display period, cuts from each treatment were analysed for colour.

Colour

Sceptrophotometric reflectance analyses were used by taking readings from the overwrapped steaks to calculate the percentage of metmyoglobin (MMb), following the procedures of Krywicki (1979).

Statistical Analysis

ANOVA procedures were used to determine between treatments over time.

A statistical analysis of the metmyoglobin accumulation of loin steaks, topside mince and rump steaks, stored at 4°C for 96 hours, is shown in Table 4.

Metmyoglobin accumulation (brown discoloration) for main effects is shown in Table 5.

Metmyoglobin accumulation of loin stakes during a shelf life study of 0-96h at 4°C is shown in Table 6.

Metmyeglobin accumulation of topside mince during a shelf life study of 0 - 96 h at 4°C is shown in Table 7.

Metmyoglobin accumulation of rump steaks during a shelf life study of 0 - 96 h at 4°C is shown in Table 8.

Metmyoglobin accumulation (brown discoloration)

According to statistical analysis, all the main effects (treatment, meat cut, shelf life period) were significantly influenced (P valves <0.05) by the accumulation of metmyoglobin (Mmb) (Table 4). Metmyoglobin gives an indication of the brown discoloration, which has taken places on each meat cut.

As shown in Table 5, the samples receiving the Anolyte treatment discoloured significantly (P=0,0147) less during the shelf life study than the control samples, the samples receiving the Catolyte or combined Anolyte-Catolyte treatment. Furthermore, the loin cuts discoloured less during the shelf life period than the other two cuts included in the study.

According to a study done by Hood, 1980, a discoloration level of 20% indicates a reduction of 50% in the amount of sales. If a cut off point of ca. 20 - 25% metmyoglobin is taken as the end of retail acceptability, the topside mince treated with Anolyte in this trial achieved a 48 hour shelf life. In contract, all the other mince samples treated (control, Catolyte, Anolyte-Catolyte combination) only achieved a 24 hour retail shelf life according to this criteria.

If this cut off point of ca 20 - 25% metmyoglobin is again applied to the rump steaks assessed during this trial, the rump steaks treated with Anolyte and

Catolyte in this trial achieved a 48 hour shelf life, while the rump steaks treated with the Anolyte-Catolyte combinations achieved a 24 hour retail shelf life. In contrast, the control samples were only acceptable on time 0 of study, i.e. a 0 hour retail shelf life, according to this criterion.

Test 17

A final test was conducted with Anolyte aimed at determining the reduction in weight loss in pig carcasses during chilling.

The carcasses were stored at about -3°C in a cold room. An Anolyte atmosphere was produced by means of fogging.

The Anolyte, generated at a total flowrate of about 750ml/min, had the following characteristics :

TDS : 6,04 g/l

pH : 6 - 8

ORP : +762mV

Application: 150 ml/m^3

The reduction in weight loss during chilling due to Anolyte fogging is shown in Table 9. A reduction of 1.32% in weight loss was measured and calculated

The treatment of an animal product as described above has been found to extend the shelf life and quality of the product as a result of the anti-microbial action of the anolyte solution.

Treatment of sausage casings for example resulted in a substantial bacterial count reduction.

The Applicant believes that the oxidising free radicals present in the anolyte solution act synergistically at a bacterial cellular level.

It has been found that the effectiveness of the anolyte solution depends upon the flow rate through the reactor which determines the concentration of the anolyte, as measured by the oxidation-reduction potential (ORP), or redox potential of the anolyte solutions, the flow rate through the reactor the exposure time, i.e. the contact time between the contaminated product surface and the anolyte solution and the temperature during application. A flow rate of 750ml/min through a pair of electro chemical cells have been found to be most effective. By measuring the redox potential of the anolyte solution during the treatment, for example, of an animal product, the available free radical concentration can be determined and monitored. Anolyte has been found to be more effective at lower than at higher temperatures and at neutral pH ranges.

It will be appreciated that many variations in detail are possible without departing from the scope and/or spirit of the invention as claimed in the claims hereinafter.

CLAIMS :

1. A method of disinfecting an animal product, the method including the step of exposing the animal product to a composition comprising an electro-chemically activated, anion-containing aqueous solution.

2. The method as claimed in claim 1, including the steps of diluting the anion-containing solution to a pre-determined concentration and exposing the animal product to an appropriate quantity of the diluted anion-containing solution and for a predetermined time period in a treatment facility.

3. The method as claimed in claim 1 including the step of producing the aqueous solution with an electro-chemical reactor, the reactor including a through flow, electro chemical cell having two co-axial cylindrical electrodes with a co-axial diaphragm between them so as to separate an annular inter electrode space into a catalytic and an analytic chamber.

4. The method as claimed in claim 1 wherein the aqueous solution has a redox potential of between +500 and +1170 mV and a pH of about 2-8.

5. The method as claimed in claim 1 including at least one of the steps of soaking, rinsing or dipping the animal product in the solution, applying the solution via an atomising or fogging process and freezing the solution and using the ice produced to pack the animal product.

6. The method as claimed in claim 5 wherein the atomising or fogging process includes the steps of atomising the solution into the atmosphere in an enclosure to be treated, forming droplets of between 5 and 100 micrometres.

7. A treatment plant for treating an animal product in accordance with the method of the invention, the treatment plant including

supply means for supplying water;

feed means for feeding a suitable salt into the water to produce an aqueous salt solution;

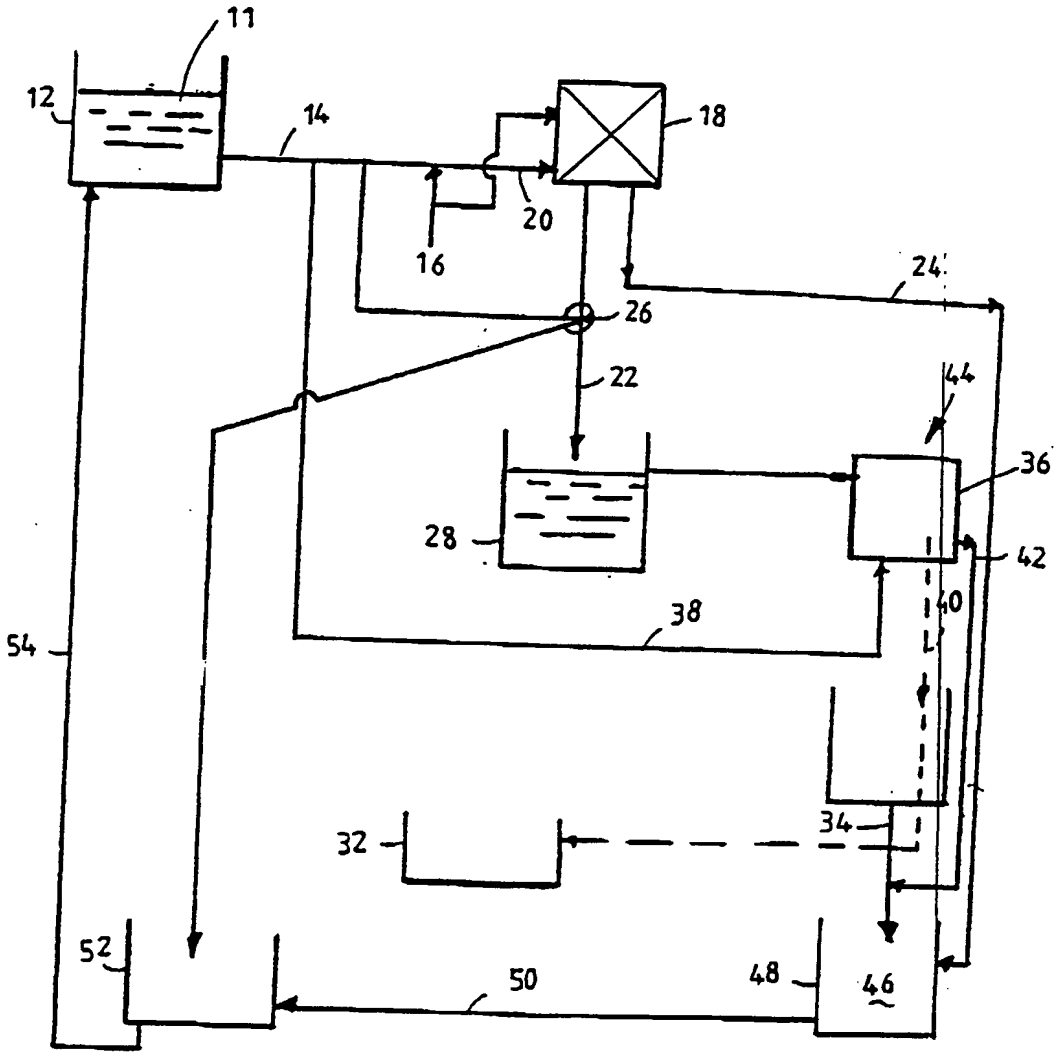
an electrolysis device for electrolysing the aqueous solution to produce an anolyte and a catholyte solution;

a mixing and dilution tank for mixing and diluting the anolyte solution; and

means for applying the anolyte solution to a product.

8. A composition for disinfecting an animal product comprising an electro chemically activated anion containing aqueous solution.

9. An animal product characterized in having been disinfected with a composition and/or in a plant and/or a process as claimed in claims 1, 8 or 9.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Treating Animal Product

Table 1

SUMMARY: ANOLYTE TEST RESULTS

No.	Description	Dilution	Summary of Results		
1	Ovine Offal:		Fresh		Frozen - 20°C - Thawed
	Organoleptic shelf life	0:0	48 hours		48 hours
	evaluation at ambient	1:10	120 hours		120 hours
	winter temperatures	1:25	120 hours		120 hours
		1:50	120 hours		120 hours
		1:100	120 hours		120 hours
2	Histopathological Changes - Bovine small Intestine	C=0:0	Cellular definition Loss after 48 hours		
	Contact time 3 min	T=1:50	Superficial layer sloughing after 120 hours		
3	Microcidal effect on Vacuum packed beef	0:0	TVC (30 days post treatment) $1,3X10^3X10^3$		Kill
	(deep tissue)	1:100	$2,1x10^2x10^2$		98,4%
4	Bovine Liver .L1 (225 mV/2 Min)	T= 1:50	TVC C $1,05X10^3X10^2$	T $3,85x10^2$	Kill 96,3%

	4,3 KG/12,5l	Test 50	Coliforms C 12 000	T 60	99,5%		
	1 2,4143 mV/2 min) 4,3 kg/12,5l		TVC C 1,05X10³x10²	T 6,0X10³	Kill 94,3%		
	1,3894 mV/2 min) 4,3 kg/12,5l		Coliforms C 12 000	T 180	98,5%		
			TVC C 1,05X10³X10²	T 5,5Xx10³	Kill 94,8%		
			Coliforms C 12 000	T 230	98,1%		
5	Beef Hides		Slaughter	Temp	Shelf Life (days)		
	T1 folded wet	1:10	<12 h	Ambient	4		
	T2 folded wet	1:10	>12 h	Ambient	3		
	T3 folded wet	1:10	2 h	Ambient	4		
	T4 folded wet	1:10	2 h	Ambient	3		
	T5 folded wet	1:10	2 h	Chilled(15°C)	17		
	T6 folded wet	1:10	2 h	Ambient	5		
	T7 folded wet	1:10	2 h	Ambient	5		
	T8 folded wet	1:10	2 h	Ambient	4		

6	Sheep Plucks	1:10	Org.	Treated	Control	
			TPC	$2,85 \times 10^3$	$2,3 \times 10^3 X 10^2$	>99%
			Pseudomonas	NG	900	>99%
7	Ostrich Offal	1:10	Org.	Treated	Control	
			TPC	$1,73 \times 10^3$	$4,944 X 10^3 X 10^2$	>99%
			E.coli	NG	8600	>99%
			Pseudomonas	NG	$2,52 X 10^2 X 10^3$	>99%
8	Fish : Hake	1:20 1:40	Both dilutions resulted in a 2-day extension of shelf life at 20°C.			
9	Sausage Casings		Org.	Treated	Control	
			TPC	240	8 160 000	
			Coliforms	NG	521 600	
			A. perfringeas	NG	8 900	

Dated this ..... Day of October 1998

Patent Attorney for the Applicant

Table 2: Statistical analysis of the Total count of the 12 Control and 12 Anolyte treated carcasses.

Source of variation	d.f.	Significance level
Treatment (control vs. anolyte)	1	0,0001

Table 3: Total counts of beef carcasses treated with Anolyte vs. a Control group.

Treatment	Log/24 cm^2
Control group after slaughter	1,6
Control group in chiller	1,2
Anolyte group after slaughter, before fogging	1,6
Anolyte group after fogging with Anolyte	0,54

Table 4: Statistical analysis of the metmyoglobin accumulation of loin steaks, topside mince and rumpsteaks, stored at 4 °C for 96 h

Source of variation	d.f.	Significance level
Treatment	3	0,0147
Meat cut	2	0,0001
Shelf life period	4	0,0001
Treatment X Meat cut	6	0,0020
Treatment X Meat cut	12	0,6302
Meat cut X Meat cut	8	0,0001

Table 5: Metmyoglobin accumulation (brown discoloration) for main effects

Main effects	Shelf life (h)	% Mmb	Std. Error
Treatment	Anolyte	24.3	0.7
	Anolyte-H20-Catolyte	27.5	0.2
	Catolyte	27.1	1.0
	Control	28.1	2.3
Meat cut	Loin steak	19.6	3.2
	Topside	30.7	2.0
	Mince		
	Rump steak	29.9	2.2
Shelf life period	0	8.2	1.3
	24	22.0	1.2
	48	28.6	1.2
	72	34.2	1.8
	96	40.7	5.1

Table 6: Metmyoglobin accumulation of loin steaks during a shelf life study of 0- 96h at 4 °C.

Main effects	Shelf life (h)	% Mmb	Std. Error
Control	0	12.9	0.7
	24	16.7	0.2
	48	21.0	1.0
	72	24.5	2.3
	96	26.7	3.2
Anolyte	0	5.2	2.0
	24	15.9	2.2
	48	22.0	1.3
	72	23.0	1.2
	96	27.0	1.2
Anolyte-H20-Catholyte	0	4.4	1.8
	24	20.2	5.1
	48	24.5	3.9
	72	20.2	3.0
	96	27.0	1.3
Catholyte	0	10.3	5.0
	24	15.9	2.5
	48	22.5	1.4
	72	25.2	0.7
	96	26.8	0.7

Table 7: Metmyoglobin accumulation of topside mince during a shelf life study of 0- 96h at 4 °C

Main effects	Shelf life (h)	% Mmb	Std. Error
Control	0	10.8	2.1
	24	24.6	1.6
	48	29.6	1.4
	72	35.7	2.2
	96	40.8	4.6
Anolyte	0	8.3	2.1
	24	19.7	2.2
	48	27.3	1.1
	72	40.8	2.8
	96	47.2	2.7
Anolyte-H20-Catholyte	0	11.5	1.9
	24	25.2	2.9
	48	36.9	2.8
	72	39.7	0.9
	96	55.7	1.7
Catholyte	0	6.7	2.4
	24	26.5	1.3
	48	34.8	1.4
	72	40.6	1.9
	96	52.8	4.7

Table 8: Metmyoglobin accumulation of rump steaks during a shelf life study of 0- 96h at 4 °C

Main effects	Shelf life (h)	% Mmb	Std. Error
Control	0	9.9	1.4
	24	32.3	1.4
	48	37.0	5.3
	72	43.9	7.5
	96	54.9	7.3
Anolyte	0	5.2	2.3
	24	24.1	1.9
	48	27.1	3.9
	72	38.0	4.4
	96	33.6	5.3
Anolyte-H20-Catholyte	0	4.5	1.8
	24	21.5	5.0
	48	32.6	3.0
	72	40.5	7.8
	96	49.1	8.1
Catholyte	0	9.0	2.8
	24	22.0	1.5
	48	27.6	2.9
	72	38.8	3.4
	96	47.6	6.9

Table 9: The effect of Anolyte Fogging on the mass loss during chilling

(Pig Carcasses)

Carcass	Warm Mass (kg)	Cold Mass (kg)	Mass (kg)% loss
C1	50.4	48.4	3.97
C2	56.4	54.5	3.37
C3	47.8	45.9	3.97
C4	50.4	48.5	3.77
C5	41.8	40.9	2.15
C6	36	34.3	4.72
A1	54	53	1.85
A2	36.4	35.1	3.57
A3	50.2	48.6	3.19
A4	44.8	44	1.79
A5	45.4	44.7	1.54
A6	47.8	46.8	2.09

3.66-2.34 = 1.32% Saving

C = Control
A = Anolyte
Numbers 1-6 = Carcass number

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US98/22370

A. CLASSIFICATION OF SUBJECT MATTER
IPC(6) :A23L 3/00; B65B 1/04
US CL : 426/235
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 426/92, 235, 236, 278, 521, 641, 652; 99/451

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

APS, IS&R
search terms: chloride?, electrolysis, electro-chemic?, meat?

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3,958,020 (DE VRIES) 18 May 1976, col. 3, lines 14-17; col. 4, lines 18-22.	1-9
Y	US 4,540,616 (GILMORE ET AL) 10 September 1985, col. 4, lines 14-47.	1-9
Y	US 4,374,714 (HEKAL) 22 February 1983, col. 2, lines 3-20.	1-9
Y	US 4,897,278 (SCHUBRING ET AL) 30 January 1990, col. 3, lines 41-44.	2
Y	US 3,892,640 (FURUTA) 01 July 1975, col. 2, lines 35-45.	7

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 11 FEBRUARY 1999	Date of mailing of the international search report 02 MAR 1999
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer DREW BECKER Telephone No. (703) 308-0651

Form PCT/ISA/210 (second sheet)(July 1992)★

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US98/22370

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☒ Claims Nos.: 9
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.